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Nutrition Knowledge, Interests, And Dietary Practices Of Female College Athletes

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NUTRITION KNOWLEDGE, INTERESTS, AND DIETARY PRACTICES OF FEMALE COLLEGE ATHLETES

KRUTO

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NUTRITION KNOWLEDGE, INTERESTS, AND DIETARY PRACTICES OF FEMALE COLLEGE ATHLETES
(TITLE)

BY

DIANE KRUTO

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ABSTRACT

The purpose of this study was to examine the nutrition knowledge, interests, and dietary practices of 69 female college athletes. The ages of the athletes ranged from 19 to 22 years. The athletes represented the basketball, softball, swimming, tennis, track and field, and volleyball teams. A self-administered questionnaire was used to collect data. A 28-item multiple-choice and true/false test was developed based on nutrition concepts identified via the literature and personal experience to be of particular importance to female college athletes. Content validity was further established by a panel of seven home economics and exercise physiology faculty. The Kuder-Richardson Formula 20 reliability coefficient calculated from study participants was 0.64. A 24-hour recall and a 2-day food record were used to determine dietary practices. The athletes received verbal instructions and a list of suggestions to aid in providing accurate food intake data. Dietary intakes were analyzed using the Nutritionist III nutrient analysis computer software.

Total knowledge scores ranged from 29% to 89% correct; mean score was 64% correct. Athletes appeared more knowledgeable about some concepts than others; however, common misconceptions, such as athletes' need for considerable protein, were held by some. Fat content of food, relationship of diet to performance, and weight loss

were topics of most interest to the athletes. Calorie/nutrient content of foods served in food service, newsletters, and other printed materials were delivery methods of most interest to the athletes. The majority of athletes' diets fell below recommended levels for energy, iron, calcium, and dietary fiber. Mean intakes reflected 54% of total calories from carbohydrate, 14% of total calories from protein, and 31% of total calories from fat, which did not meet current recommendations for athletes. No significant differences in knowledge, interests or dietary intakes were found among athletes participating on different sport teams, thus nutrition education programs may not need to be targeted to each individual sport.

DEDICATION

To my fiance, Jeff, and my family for their love and support. It was with their continuous support that I was able to complete this project.

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I would like to thank all my friends and family who listened and encouraged me throughout this project. I would like to thank all of the coaches of the women's athletic teams at Eastern Illinois University, who agreed to the study. Also, thanks to all of the athletes who participated in the study.

I would like to thank my committee members, Dr. Jayne Ozier and Dr. Martha Brown, for their contributions. A special thank you to my advisor, Dr. Carol Ries, whose patience encouraged me to continue. Her valuable input contributed to the successful completion of this project.

PREFACE

This thesis has been written in an alternative format approved by the Eastern Illinois University Graduate School and the School of Home Economics.

Part One and Part Two are written as separate manuscripts to be submitted for publication in specific professional journals. The format for each of these manuscripts is consistent with the author guidelines of that journal.

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INTRODUCTION

As the number of women participating in sports increases, there is a growing interest in the nutrition knowledge and practices of the female athlete. Athletes are known for seeking the competitive edge that may give them an advantage over their opponents. The potential to influence athletic performance is dependent on a variety of factors, including the nutritional status of the athlete. Athletes look for any type of competitive edge through training, psychology, and/or dietary manipulation. When striving for maximal athletic performance, the importance of healthful dietary habits is often overlooked.

Although research in the area of sports nutrition is increasing, limited research has been done on the nutrition knowledge, behavior, and interests of female college athletes. Research in this area could be beneficial in regard to influencing athletic performance and improving the health status of athletes. Research on female college athletes is needed to develop effective nutrition education for athletes.

The purpose of this study was to determine the nutrition knowledge, practices, and interests of female college athletes. The specific objectives that were identified and addressed in the study were:

* to determine the knowledge level of female college athletes on sports-related nutrition

* to compare the knowledge level of female college athletes participating in various sports
* to evaluate the dietary practices of female college athletes
* to explore the level of interest of female college athletes in nutrition education
* to determine the nutrition topics of most interest to female college athletes
* to determine female college athletes' preferred delivery methods for nutrition information

Review of Literature

The purpose of this study was to determine the nutrition knowledge, interests, and dietary practices of female college athletes. This review will examine the nutrition knowledge, interests, and dietary practices of both college and high school athletes.

Nutrition Knowledge

As the number of women participating in sports increases, a variety of nutrition knowledge studies have focused on female athletes. The potential of nutrition to influence athletic performance has received increased attention. Athletes may find themselves exposed to both valid information and information with questionable validity. Therefore, athletes cannot be assumed to have the nutrition knowledge necessary to obtain diets associated with optimal performance. Nowak, Knudsen, and Schulz (1988) suggested that the dietary regimen needed to achieve optimal performance requires a level of nutrition knowledge that may not be present.

Barr (1987) and Schoaf, McClellan, and Birskovich (1986) found the nutrition knowledge of college athletes to be poor while other researchers (Perron & Endres, 1985) have found female athletes to be generally knowledgeable about nutrition. Athletes not only need to be knowledgeable about general nutrition but athletes also should be aware of the specific nutrition principles related to optimal athletic

performance. Barr found that female college athletes scored significantly better on statements that assessed general nutrition knowledge than on statements that assessed knowledge on sports nutrition. Perron and Endres reported similar results from a study with female high school athletes.

Several researchers have found athletes to be least knowledgeable about some specific topics (Perron & Endres, 1985; Schoaf et al., 1986; Werblow, Fox, & Henneman, 1978). Perron and Endres found female high school athletes to be least knowledgeable about the role of protein in the diet and about carbohydrate loading. Werblow et al. reported similar results in that female athletes were least knowledgeable about protein foods in the diet and about the role of carbohydrates. Male college athletes were found to be least knowledgeable about the sources of carbohydrates, the recommended body fuel, the primary energy sources, and the recommendations for the pregame meal (Schoaf et al.). All of these topics are related to optimal performance (American Dietetic Association [ADA], 1987), therefore, indicating a need for nutrition education.

Some researchers (Perron & Endres, 1985; Werblow et al., 1978) identified factors that affected the nutrition knowledge levels of athletes studied. Perron and Endres reported a positive correlation between nutrition knowledge and attitude among female high school athletes. Werblow et al. found similar results among female college athletes but

also found that athletes who had previously taken a nutrition course in high school or college scored significantly better on a nutrition knowledge test.

To assess changes in nutrition knowledge after receiving nutrition education, Potter and Wood (1991) compared the effectiveness of self-instruction versus group-instruction. The group instruction consisted of viewing slides and listening to audiotapes on sports nutrition. The self-instruction consisted of viewing the slides but reading a text rather than listening to audiotapes. The mean post-test score for those athletes participating in the self-instruction was significantly higher than the mean score for those participating in the group instruction. However, both methods resulted in significantly higher post-test scores which indicated both methods were effective.

Interests

Various researchers (Barr, 1987; Perron & Endres, 1985; Schoaf et al., 1986; Werblow et al., 1978) have reported that athletes have a high interest in nutrition. Schoaf et al. found many male college athletes were interested in nutrition with many planning to take a nutrition course. Werblow et al. and Perron and Endres found female athletes to have generally favorable attitudes toward nutrition.

There is limited research on the topics of specific interest to athletes. However, assessing athletes' interests is an important factor when designing a nutrition education program. Researchers have found weight loss to be

the topic of most interest among the majority of female athletes (Perron & Endres, 1985; Werblow et al., 1978). Perron and Endres found that many high school athletes were interested in weight control and the majority wanted to lose weight. Werblow et al. also found female athletes most interested in weight control with many using weight control as the basis for their diets. Other topics of interest among female athletes were nutrition counseling and recommendations for eating for good health (Werblow et al.).

The sources of information most commonly used by athletes has been reported by various researchers (Barr, 1987; Parr, Porter, & Hodgson, 1984; Schoaf et al., 1986). Both legitimate sources and sources with questionable validity are available to athletes. A wide variety of information sources are used by athletes, however, Barr and Parr et al. found printed materials to be the sources most often used by many athletes. Barr reported magazines and books to be the primary sources. Other commonly used sources reported were friends and teammates, high school and community courses, newspapers, university courses, and coaches. Barr found registered dietitians to be one of the least used sources for nutrition information. In contrast to the studies by Barr and Parr et al., Schoaf et al. indicated male athletes reported parents, high school physical education and health courses, college health courses and home economics courses, and high school coaches

to be sources most frequently used for nutrition information.

Updegrove and Johnson (1987) developed table tents containing sports nutrition facts to use with a college football team at the training tables. Since the majority of these athletes felt the table tents were useful, table tents may be an effective method to present nutrition information to athletes.

Dietary Practices

Researchers (ADA, 1987; McArdle, Katch, & Katch, 1991) have identified the relationship between optimal athletic performance and dietary intake . Often athletes try to manipulate their dietary intakes to influence their athletic performance which may result in poor dietary habits (McArdle et al.). Many researchers (Barr, 1987; Hickson, Schrader, & Trischler, 1986; Manore, Besenfelder, Wells, Caroll, & Hooker, 1989; Nowak et al., 1988; Perron & Endres, 1985; Short & Short, 1983; Tilgner & Schiller, 1989) have reported that the dietary intakes of female athletes fall below the Recommended Dietary Allowances (RDA) for calories and many nutrients. Calories, iron, and calcium intakes most frequently fall below the RDAs. An investigation by Welch, Zager, Endres, and Poon (1987) revealed female athletes' diets were low in calories and nutrients.

Tilgner et al. (1989) conducted a study with female college basketball players. The pattern of food choices among the athletes was found to be poor, which resulted in

insufficient intakes of several nutrients when compared to the RDAs. The diets of the athletes were low in fiber and reflected limited consumption of whole grains, fruit, and vegetables. The inclusion of these foods in the diets of athletes is imperative due to the significant role of carbohydrates in athletic performance (ADA, 1987). In addition, Tilgner et al. found that female athletes required guidance in selecting nutrient-dense foods. Nowak et al. (1988) also found that the need for better food choices among women athletes was apparent from their dietary intake, which did not provide the level of nutrients recommended to promote optimal athletic performance.

To investigate the potential role of a foodservice facility in promoting optimal nutritional intake for athletes, a study was conducted with a men's college soccer team (Hickson, Johnson, & Schrader, 1987). The dietary intakes of the male athletes living off-campus were compared with intakes of male athletes living on-campus and eating their meals at the university foodservice facility. The researchers found that eating at the foodservice resulted in a more desirable pattern of nutrient intake. The on-campus athletes consumed a higher percentage of calories from carbohydrates than the off-campus athletes and their diets more closely reflected the recommendations for optimal performance. Researchers concluded that a university foodservice represents a controlled feeding situation and such control may be used to promote an optimal diet for

college athletes, therefore promoting optimal athletic performance.

Limited research has been done on the effectiveness of nutrition education on dietary intakes of athletes. A study by Welch et al. (1987) examined the effectiveness of individual nutrition counseling on the dietary intakes of female college athletes. When comparison was made between the control group and counseled group, the intakes of the counseled group more closely reflected the dietary recommendations for athletes. The counseled group showed significantly higher percentages of total calories from carbohydrates and significantly lower percentages of total calories from fat. The counseled group also had higher iron and calcium intakes. Intakes of these nutrients previously were reported as being low among female athletes. The counseled athletes made substantial changes in food choices after counseling and began choosing more nutrient-dense foods. Overall, those athletes who received nutrition counseling showed substantial improvements in the quality of their diets, which suggests the nutrition education was effective.

When discussing dietary intake among athletes, the topic of weight control techniques must be addressed. Often athletes, particularly male wrestlers and female athletes, practice many behaviors to control their body weight (McArdle et al., 1991). Such behaviors may lead to eating disorders.

Welch et al. (1987) have found that many female athletes manipulate their diets to control their weight during training. Results of a study of 182 female college athletes showed that 32% practiced at least one potentially dangerous weight-control technique (Rosen & Hough, 1988). Many female athletes not only may be preoccupied with their weight but also may be dissatisfied with their body shape or size, which may result in some behaviors characteristic of anorexia nervosa and/or bulimia (Borgen & Corbin, 1987). Borgen and Corbin found the incidence of anorexia nervosa and bulimia to be high among female athletes and suggested that sports may contribute to the development of these eating disorders. Both anorexia nervosa and bulimia are prevalent among girls who are oriented to high achievement and female college athletes fall into this category. Borgen and Corbin suggested that female athletes in sports that emphasize leanness, such as gymnastics, dancing, and ice skating, may be especially at risk. Nowak et al. (1988) found that diets of female college basketball players were inadequate due to the desire to be light and aesthetically appealing.

Welch et al. (1987) reported that female athletes are generally taller and heavier but leaner than nonathletic women of the same age. Height and weight charts designed for the general, less active population may encourage unrealistic weight goals for female athletes. Due to a greater proportion of lean muscle weight, female athletes

are often heavier than the charts suggest is normal (Welch et al.). Since athletes concerned about their weight often try to lose weight during training, female athletes must be aware of these differences to prevent unnecessary weight loss. It has been suggested that decisions regarding optimal weight should be based on total body composition rather that on weight or appearance alone (Welch et al.).

Based on the studies discussed in this review, it is apparent that the information on the nutrition knowledge, interests, and dietary intakes among athletes is not consistent. The need for nutrition education among athletes is also apparent. Further research is needed in this area to help nutrition educators develop and implement effective nutrition education programs and materials for athletes.

PART ONE

Nutrition Knowledge, Interests, and Preferred Educational Methods of Female College Athletes

Introduction

As the number of women participating in sports increases, there is a growing interest in the nutrition knowledge and practices of the female athlete. Athletes are known for seeking the competitive edge that may give them an advantage over their opponents (1). As athletes try to enhance their athletic performance by manipulating their dietary intakes, the importance of healthful dietary habits is often overlooked (2). It has been suggested that dietary intake is related to the level of nutrition knowledge (3). Although the nutrition knowledge of female athletes in general has been found to be low (2,4), limited specific research has been done on the knowledge of female athletes at the college level. There has also been limited research examining the most viable ways to educate athletes about sports-related nutrition.

A study was conducted to examine the nutrition knowledge, interests, and dietary practices of female college athletes. Information about the dietary practices and the relationship to nutrition knowledge are reported elsewhere (5). This article describes the nutrition knowledge and interests of these athletes. Specific study objectives were to examine 1) what and how much female

college athletes know about sports-related nutrition, 2) how interested these athletes are in nutrition education, 3) what specific nutrition topics are of most interest to them, and 4) what specific methods of nutrition information delivery they would prefer. An additional objective was to compare nutrition knowledge and interests among female athletes participating in different sports. This information will be helpful in determining the need for nutrition education and in designing effective nutrition education programs for female college athletes.

Methodology

Data collection instruments. A self-administered questionnaire was developed for the study to assess knowledge, level of interest in specific sports-related nutrition topics and in nutrition information delivery methods, and demographic data.

The knowledge test consisted of 14 multiple-choice and 14 true/false items that dealt with various sports-related nutrition topics. Nutrition concepts particularly important for athletes were identified through review of sports nutrition articles and books and based on personal experiences with college athletes. Test items were then constructed to assess knowledge of these concepts. Content validity was further established by review of a panel of seven nutrition, home economics, and exercise physiology faculty. The Kuder-Richardson Formula 20 reliability

coefficient for internal consistency (6) on the study sample was 0.64.

Using a three point scale of 2 = very to 0 = not at all, athletes were asked to indicate their interest in nine nutrition topics and seven methods of nutrition education identified from the sports nutrition literature and through personal experience. Demographic questions assessed age, class standing, housing status, sport, and prior nutrition education. The entire questionnaire was refined based on examination by the seven experts and was then pilot tested with six female college athletes not participating in the study.

Data collection. The coaches of each women's varsity team (basketball, softball, swimming, tennis, volleyball, and track and field) at a small midwestern university approved the research project and assisted the researcher in scheduling team data collection meetings. Questionnaires were administered to members of each team in separate group settings with the exception of members of the swim team who met individually with the researcher due to difficulty arranging a convenient meeting time for the entire team. The swim team was the only team not currently practicing or competing at the time of the study. The researcher distributed the questionnaires to each athlete and gave verbal instructions. Each questionnaire was pre-coded for confidentiality (7).

Data analysis. Knowledge test items were scored by giving one point for a correct response and zero points for an incorrect response. Scores for each item were added to compute a total score. Possible total knowledge scores ranged from 0 to 28 points. Levels of interest in the specific nutrition topics and nutrition education methods were measured by using the following scale: 0 = not at all interested, 1 = somewhat interested, and 2 = very interested.

Data from the questionnaires were entered into the computer and analyzed using the Statistical Analysis System (8). Descriptive statistics were determined for all variables. An analysis of variance and Waller-Duncan test was conducted to test for team differences in total knowledge scores. Chi-square analyses were also used to test for team differences in levels of interest in the specific nutrition topics and nutrition information delivery methods. However, since the numbers of athletes in some of the specific sports were very small, Chi-square may not be a valid test of these differences.

Results

Sample characteristics. The sample for this study consisted of 69 members of the women's softball (15), track and field (15), swimming (13), volleyball (10), tennis (9), and basketball (7) teams; 64% of the total team membership participated. Athletes ranged in age from 17 to 22 years;

mean age was 18.6 years. All class levels were represented with 41% freshmen, 23% sophomores, 20% juniors, and 16% seniors. Most (77%) reported living in campus residence housing, the rest lived off campus by themselves or with roommates (20%), in a sorority residence (1.5%), or off campus with parents (1.5%). Only 13% reported they had taken a college course specifically devoted to nutrition.

Nutrition knowledge. Athletes were asked to respond to 28 knowledge items related to sports nutrition topics. Scores ranged from 8 (29%) to 25 (89%) correct, with a mean score of 17.8 $\pm$ 3.6 points (64% correct). Analysis of variance indicated there were no significant differences in total scores of female athletes participating in different sports.

The percentages of correct responses to each item are presented in Table 1. Athletes tended to score better on true/false items than on multiple-choice items. Results from true/false items suggested almost all of these athletes knew that caloric needs of athletes vary, that athletes may weigh more than their nonathletic counterparts due to increased muscle tissue, and that drinking water during exercise will not generally cause upset stomach or reduced speed. Most seemed aware that weight loss is not necessary when extra weight is due to increased muscle tissue, and that candy, caffeine, and sports drinks will not significantly enhance athletic performance for most athletes. Slightly more than half correctly indicated that increased protein intake will not increase muscle tissue

size or strength and that decisions about weight gain, loss, or maintenance should not be based on how many pounds one weighs. Almost two-thirds, however, erroneously indicated that muscle cramps are almost always due to potassium or sodium deficiencies.

Results from multiple-choice items suggested most athletes knew that cool water was the recommended fluid replacement drink, and that low iron intakes increase the risk of anemia. One fourth or fewer seemed to know that the protein needs of athletes are not substantially higher than nonathletes, that an athlete's main sources of energy are carbohydrate and fat, and that the best post-event meal is one high in carbohydrate. Only one-third of athletes were able to identify good sources of carbohydrate.

Interest in nutrition topics and nutrition education methods. Athletes were asked to indicate how interested they were in nine specific nutrition topics. Results are presented in Table 2. With the exception of weight gain, most of these female athletes seemed to be at least somewhat interested in all of the nutrition topics listed. Topics of most interest were the fat content of foods, the relationship of diet to performance, and weight loss. Topics of interest that were not included on the list were vegetarianism and the use of diuretics and laxatives each of which was mentioned by one participant. Chi-square analyses indicated few significant differences among sports with regard to interest although athletes from the basketball,

softball and volleyball teams were more interested in the topic of weight gain than were athletes from the other teams ($p=0.05$).

To explore possibilities for nutrition education for this target population, participants were also asked to indicate their interest in receiving nutrition information via a number of different delivery methods (Table 2). Almost all of these female college athletes were interested in having calorie and nutrient content information presented for foods served in food service. Most athletes were also at least somewhat interested in regular newsletters and other printed materials such as pamphlets and flyers. These athletes were least interested in the use of a nutrition hotline and in videotapes as delivery methods for nutrition information. Chi-square analyses indicated there were no significant differences in the interest levels of the female college athletes among sport teams.

Discussion

Nutrition knowledge. The female athletes in this study appeared generally knowledgeable about sports-related nutrition. The mean knowledge score of 64% compares favorably with the results from other studies (2,4,9-11). Perron and Endres (9) assessed the knowledge level of female high school volleyball players and found a total knowledge score of 66% while Werblow, Fox and Henneman (2) reported a total score of 68% for female college athletes. Potter and

Wood (10), Schoaf, McClellan, and Birskovich (11), and Barr (4) reported total scores of 50%, 43%, and 34%, respectively. Direct comparison of knowledge is difficult, however, due to the use of different knowledge tests.

These athletes seemed more knowledgeable about some topics than others. Most seemed aware that they might weigh more than their nonathlete peers due to extra muscle tissue and that weight loss is not necessary in those circumstances. This apparent knowledge is reassuring since athletes must be aware of these differences to avoid unnecessary and possibly dangerous weight-control measures. Barr (4) reported that female athletes were significantly taller and heavier than their nonathlete counterparts.

The majority of the female athletes in this study also seemed knowledgeable about fluid recommendations. Most identified plain cool water as the recommended replacement fluid and seemed to know that drinking sports drinks during exercise will not improve the performance of most athletes. Water is considered sufficient to meet the fluid needs of most athletes exercising in moderate climatic conditions. Sports drinks have not been found to significantly enhance performance but have been found to provide psychological rather than physiological benefits (12). Most of these athletes also seemed aware that drinking water during exercise will not negatively affect performance. This is also encouraging since proper hydration is essential for

athletic performance, and dehydration can result in serious complications (12).

Athletes in this study still appeared to hold some common misconceptions about sports-related nutrition, however, and to lack knowledge of some topics. Misconceptions commonly reported among athletes are that they need much more protein than do nonathletes and that extra protein will result in bigger and stronger muscles (1,2,9). Many of these athletes seemed to also believe these myths. Not all investigators have found this to be the case. The male athletes studied by Schoaf et al. (11) knew that increased muscle mass resulted primarily from increased use of muscles. A diet providing 12-15% of total calories from protein is considered sufficient to provide adequate protein and high consumptions may result in a variety of complications for athletes (12).

Most of these athletes did not seem to know that carbohydrate and fat are the main energy sources used for exercise. This result is consistent with other studies (2,11). Many of these athletes were not able to identify good sources of carbohydrates. Schoaf et al. (11) also found that athletes were not very knowledgeable about sources of carbohydrates. An athlete's diet should include 60-70% of total calories from carbohydrates (12). To meet this recommendation, athletes must know which foods are good sources.

These athletes seemed more knowledgeable about the pre-event meal than about the post-event meal. Very few could identify the recommended composition of the post-event meal; the majority indicated it should be high in protein. A post-event meal high in carbohydrates is considered beneficial to replenish the glycogen stores of the athlete (1).

Interest in nutrition topics and nutrition education methods. In general, these athletes appeared quite interested in most of the nutrition topics listed; weight loss was a primary topic of interest. Many other researchers have found similar results (2,9,13). Werblow et al. (2) and Parr, Porter, and Hodgson (13) reported athletes were most interested in weight control. Perron et al. (9) stated 81% of athletes were concerned with their weight and 73% wanted to lose weight.

Another topic of interest to these athletes was the fat content of foods. This interest may be at least partly due to the health concern related to high consumptions of fat. A high intake of fat can also be related to weight gain and this may be a factor since many of these athletes were interested in weight loss.

Relationship of diet to performance was another topic of interest to these athletes. Athletes are interested in what foods to eat and how much to eat for optimal performance (1). Knowing this information may help athletes

to consume a diet adequate for optimal performance and good health (3).

Calorie and nutrient content of foods served in food service was the delivery method of greatest interest to these athletes. This suggests female athletes are interested in the nutritive value of foods served in food service. Providing the calorie, carbohydrate, protein, and fat content of foods may help athletes meet current recommendations for pre-event and post-event meals.

Newsletters and other printed materials were additional nutrition information delivery methods of interest to these athletes. These findings are consistent with the results of previous studies (4,10). Barr (4) found athletes to be most interested in printed materials. Potter et al. (10) reported athletes were interested in including printed materials in nutrition education. Since participating in college athletics requires a great deal of time, athletes may feel that printed materials would more easily fit into their schedules and would allow them to learn at their own pace.

Potter et al. (10) developed a slide set on sports-related nutrition topics for college athletes. Those athletes who viewed the slides individually and read the script at their own pace had a significantly higher knowledge score than those who viewed the slides and listened to an audiotape. This study demonstrates the

effectiveness of including printed materials in educating college athletes on sports-related nutrition.

Table tents and posters in food service were also of some interest to the athletes. Updegrove and Johnson (14) developed table tents to present nutrition information to male athletes at training tables. Although many women's teams do not utilize training tables, posters or bulletin boards may be useful if displayed in the food service and the locker and training rooms of athletes.

Conclusions

Although the results of this study suggest that many female college athletes are fairly knowledgeable about sports-related nutrition, and that most are knowledgeable about some topics, there is still a need for nutrition education for less knowledgeable athletes, especially in some topical areas. Furthermore, in any study with a response rate of less than 100%, one must be concerned about the potential for non-response bias. There is a possibility that athletes participating in this study were more interested in and knowledgeable about sports-related nutrition than those who chose not to participate. Therefore, the data could indicate a greater knowledge and interest than actually exists among female college athletes. Although this possibility exists, the response rate was comparable to that obtained in other studies (2,4).

More education materials are needed to address topics of interest to female athletes. Such topics should include general dietary recommendations, the relationship of nutrition to performance, and weight control. Athletes seem to be interested in a variety of delivery methods; however, providing the calorie and nutrient content of foods at the point of purchase and printed materials such as newsletters and pamphlets may be most effective in presenting nutrition information.

The results of this study suggest that there are no substantial differences in knowledge level or in topics or delivery methods of interest among female athletes participating in different sports. This suggests that nutrition education programs would not necessarily need to be targeted to athletes in one specific sport. Additional research with a larger sample is needed to confirm these findings. Future studies are also needed that focus on developing and evaluating nutrition education materials for college athletes.

Table 1. Responses of female college athletes to knowledge items: frequency distributions

Knowledge Test Concepts	Female College Athletes Selecting the Correct Response N	%
True/false items:		
Caloric needs of athletes vary	66	96
Weight of athletes vs. nonathletes	66	96
Water intake and performance	63	91
Weight assessment and body composition	60	87
Candy intake and performance	58	84
Caffeine intake and performance	58	84
Sports drinks and performance	58	84
Development of eating disorders	57	83
Appropriateness of glycogen loading	51	74
Vit/min supplements and performance	50	73
Type carbohydrates recommended	48	70
Increased protein intake and muscle tissue	41	59
Weight assessment criteria	36	52
Potassium/sodium intake and muscle cramps	25	36
Multiple choice items:		
Type fluid recommended	59	86
Iron intake and anemia	57	83
Calcium intake and stress fractures	55	80
Sources of complex carbohydrates	46	67
Timing of pre-event meal	43	62
Electrolyte replacement after event	40	58

(Continued)

(Table 1 continued)

Composition of pre-event meal	39	57
Fluid replacement amount after event	36	52
% calories from carbohydrate recommended	32	46
Fluid intake during event	28	41
Sources of total carbohydrate	23	33
Protein needs of athletes vs. nonathletes	17	25
Main energy sources used for exercise	12	17
Composition of post-event meal	6	9

Table 2. Frequency distribution and means of topics and delivery methods of interest to female college athletes

	Degree of Interest:[1] Very	Somewhat	Not	
Topics:	%	%	%	Mean ± S.D.[2]
Fat content of foods	67	28	6	1.61 ± 0.60
Relationship of diet to performance	64	28	7	1.57 ± 0.63
Weight loss	62	23	14	1.48 ± 0.74
General dietary recommendations for good health	45	49	6	1.39 ± 0.60
Fluid intake	39	52	9	1.30 ± 0.63
Calorie content of foods	35	54	12	1.23 ± 0.65
Carbohydrate content of foods	35	52	13	1.22 ± 0.66
Nutrient supplements	23	58	19	1.04 ± 0.65
Weight gain	30	17	52	0.78 ± 0.89
Delivery Methods:				
Calorie/nutrient content of foods served in food service	65	30	4	1.61 ± 0.57
Regular newsletters	46	43	10	1.36 ± 0.66
Printed materials	38	52	10	1.28 ± 0.64
Table tents, posters in food service	40	37	24	1.16 ± 0.78
Seminars	17	51	32	0.86 ± 0.69
Vidoetapes	12	55	33	0.78 ± 0.64
Nutrition hotline	12	26	62	0.49 ± 0.70

[1] Percent does not always equal 100% due to rounding.
[2] Mean (± Standard Deviation) calculated using the following scale: 0 = not at all interested
1 = somewhat interested
2 = very interested

NOTES AND REFERENCES

1. McArdle, W.D., F.I. Katch, and V.L. Katch. Exercise physiology: energy, nutrition, and human performance, Third ed. Philadelphia: Lea & Febiger. 1991. p. 497.
2. Werblow, J.A, H.M. Fox, and A. Henneman. Nutritional knowledge, attitudes, and food patterns of women athletes. Journal of the American Dietetic Association 73:242-245, 1978.
3. Carruth, B.R., M. Mangel, and H.L. Anderson. Assessing change - proneness and nutrition-related behaviors. Journal of the American Dietetic Association 70:47, 1977.
4. Barr, S.I. Nutrition knowledge of female varsity athletes and university students. Journal of the American Dietetic Association 87:1660-1664, 1987.
5. Kruto, D. (1993). Nutrition knowledge, interests, and dietary practices of female college athletes. Unpublished master's thesis, Eastern Illinois University, Charleston, Illinois.
6. Gronlund, N.E. Measurement and evaluation in teaching, Third ed. New York: Macmillan Publishing. 1976. pp. 111-113.
7. Research protocol was consistent with university guidelines.
8. SAS Institute, Inc. SAS user's guide: statistics, Version 6.06. Cary, N.C. 1989.

9. Perron, M. and J. Endres. Knowledge, attitudes, and dietary practices of female athletes. Journal of the American Dietetic Association 85:573-576, 1985.

10. Potter, G.S. and O.B. Wood. Comparison of self- and group-instruction for teaching sports nutrition to college athletes. Journal of Nutrition Education 23:288-290, 1991.

11. Schoaf, L.R., P.D. McClellan, and K.A. Birskovich. Nutrition knowledge, interests, and information sources of male athletes. Journal of Nutrition Education 18:243-245, 1986.

12. Nutrition for physical fitness and athletic performance for adults: Technical support paper. Journal of the American Dietetic Association 87:934-938, 1987.

13. Parr, R.B, M.A. Porter, and S.C. Hodgson. Nutrition knowledge and practice of coaches, trainers, and athletes. Physician and Sportsmedicine 12(3):126-138, 1984.

14. Updegrove, N.A. and R.M. Johnson. Using table tents to present sports nutrition facts to collegiate athletes. Journal of Nutrition Education 19:302D, 1987.

PART TWO

DIETARY PATTERNS AND NUTRIENT INTAKES OF FEMALE COLLEGE ATHLETES

Introduction

As the number of women participating in sports increases, there is a growing interest in the nutrition knowledge and dietary intake of female athletes. Most athletes are concerned with optimal performance; however, the nutrition knowledge and practice to support such achievements may not be present. Athletes are known for seeking the competitive edge that may give them an advantage over their opponents (1). Often athletes try to enhance their athletic performance by manipulating their dietary intakes, which often results in overlooking the importance of healthful dietary habits (2). The dietary intakes of female athletes have been found to fall below the Recommended Dietary Allowances (RDA) (3) for energy and many nutrients (4-8). It has been suggested that dietary intake is related to the level of nutrition knowledge (9). Some research on the nutrient intakes of female college athletes has been done; however, few studies have reported the types of foods consumed by female college athletes. More research is needed to develop effective nutrition education for this population.

A study was conducted to examine the nutrition knowledge, interests, and dietary practices of female

college athletes. Specific information on these female athletes' nutrition knowledge and interest is reported elsewhere (10). Specific study objectives were to examine 1) how intakes compare with current dietary recommendations for athletes, and 2) possible relationships between nutrition knowledge level and dietary intakes of these athletes. An additional objective was to compare dietary intakes among female athletes participating in different sports. This information will be helpful in determining the need for nutrition education for female college athletes and for developing relevant nutrition education programs.

Methodology

Data collection instruments. Dietary intakes were assessed using one 24-hr recall and a 2-day food record. The recall method was used to familiarize the athletes with the technique of recording food intake in preparation for the two-day food records.

A self-administered questionnaire was used to assess knowledge and demographic data. The knowledge test consisted of 14 multiple choice and 14 true/false items that dealt with various sports-related nutrition topics. Nutrition concepts particularly important for athletes were identified through review of sports nutrition articles and books and based on personal experiences with college athletes. Test items were then constructed to assess knowledge of these concepts. Content validity was further

established by review by a panel of seven nutrition, home economics, and exercise physiology faculty. The Kuder-Richardson Formula 20 reliability coefficient for internal consistency (11) on the study sample was 0.64. Demographic questions assessed age, class standing, housing status, sport, and prior nutrition education. The entire questionnaire was refined based on examination by the seven experts and was then pilot tested with six female college athletes not participating in the study.

Data collection. The coaches of each women's varsity team at Eastern Illinois University (basketball, softball, swimming, tennis, volleyball, and track and field) approved the research project and assisted the researcher in scheduling team data collection meetings. Both data collection instruments (food intake recording forms and knowledge test) were distributed to members of each team in separate group settings with the exception of members of the swim team who met individually with the researcher due to difficulty arranging a convenient time for the entire team. The swim team was the only team not currently practicing or competing at the time of the study. The researcher gave verbal instructions for each instrument separately. The knowledge test and 24-hr recall were completed at the group meetings. Athletes were instructed to record two weekdays for the food record. The food record form included written instructions and a list of suggestions to help the athletes provide accurate, specific records. Completed food records

were either returned to the coaches or mailed to the researcher. Instruments were pre-coded for confidentiality.

Data analysis. Food data from the 24-hr recall and 2-day food records were coded and the nutrient composition was determined using Nutritionist III computer software (version 6.0, 1990). Analyses of energy and six nutrients (protein, carbohydrate, fat, iron, calcium, and vitamin C) plus dietary fiber, percent energy from each macronutrient, and a tabulation of the number of exchanges in each food exchange group were performed (12). Nutrient intakes were compared with the RDA appropriate for each athletes age. Energy intakes of the athletes were compared with individual energy needs calculated using the Harris-Benedict equation (13) which included each individual athlete's height, weight, age, and a 1.2 activity factor. When not specified, it was assumed milk was 2%, bread was white enriched, margarine was used on toast, and stew was prepared with beef.

Knowledge test items were scored by giving one point for a correct response and zero points for an incorrect response. Scores for each item were added to compute a total score. Possible total knowledge scores ranged from 0 to 28 points.

Data from the knowledge test and food records were analyzed using the Statistical Analysis System (SAS, 1989). Descriptive statistics were determined for all variables. Analyses of variance were conducted to test for team

differences in intakes of calories, protein, carbohydrates, fat, iron, calcium, vitamin C, and dietary fiber, percent calories from each macronutrient, and the number of exchanges consumed in each food exchange group. Pearson product-moment correlational analyses were used to test for relationships between knowledge scores and dietary intake variables for the total sample and separately for each sport.

Results and Discussion

Sample characteristics. The sample for this study consisted of 69 members of the women's softball (15), track and field (15), swimming (13), volleyball (10), tennis (9), and basketball (7) teams; 64% of the total team membership participated. Athletes ranged in age from 17 to 22 years; mean age was 18.6 years. All class levels were represented with 41% freshmen, 23% sophomores, 20% juniors, and 16% seniors. Most (77%) reported living in campus residence housing, the rest lived off campus by themselves or with roommates (20%), in a sorority residence (1.5%), or off campus with parents (1.5%). Only 13% reported they had taken a college course specifically devoted to nutrition.

Dietary intake. Athletes were asked to complete one 24-hour recall and one two-day food record. A 72% return rate was obtained for the food records. Mean results from the nutrient analyses of the three days are presented in Table 1. Analyses of variance indicated there were no

significant differences in dietary intakes of female athletes participating in different sports.

Mean caloric intake of athletes in this study (1893 $\pm$ 597) was comparable with results from previous studies (4-6,15). Manore et al. (5) reported a mean caloric intake of 1786 calories for female long distance runners and Nowak et al. (6) reported a mean intake of 1730 calories for female college basketball players. Welch et al. (15) found that female college athletes consumed an average of 1788 calories during their study. Hickson et al. (4) reported an average intake of 1995 calories for female basketball players. In the present study, almost all athletes' intakes (90%) fell below the recommended calorie level; 45% consumed less than two-thirds of the recommended calorie level. This low calorie level may be at least partly a reflection of underreporting of actual food intake (16). Although most intakes fell below recommended levels, casual observation of the athletes participating in this study revealed the athletes did not appear to be at a high risk for low body weight. Short and Short (7) reported substantial differences in the caloric intakes of athletes participating in various sports; however, the results from this study of female athletes do not support that finding.

Almost all athletes (91%) met the RDA for protein with most (61%) exceeding the RDA by 30% or more. It is important to discourage athletes from consuming high amounts of protein since a high protein intake may diminish the

amount of carbohydrates consumed. Mean percentage of total calories from protein in this study (14%) was consistent with results from other studies of athletes (4-8) (13% to 16%). It is recommended that athletes consume 12-15% of total calories from protein (17). Protein calories of fewer than half of these athletes (43%) were in this recommended range; 35% consumed more than 15% and 21% consumed less than 12% of their calories from protein.

Mean percentage of total calories from carbohydrates (54%) was in agreement with Nowak et al. (6) who reported that female athletes in their study consumed 52% of calories from carbohydrates. The recommendation for athletes is to consume 60-70% of total calories from carbohydrates (17). Few athletes (16%) had carbohydrate intakes within this recommended range. The majority of athletes (80%) fell below this range while only 4% were above this recommended range. Most athletes in this study needed to consume more calories from carbohydrates. Complex carbohydrates are the recommended carbohydrate source for athletes (17).

Athletes in this study consumed 31% of their total calories from fat. This result is similar to results from other studies (6,8). Nowak et al. (6) and Tilgner and Schiller (8) reported athletes consumed 32% and 33% of total calories from fat, respectively. Although 31% is slightly above the recommended 25-30% of total calories from fat, it is an improvement over typical American dietary practices (1). Welch et al. (15) found that athletes who

received nutrition counseling significantly improved their diets and that the percentage of calories from the macronutrients more closely reflected the recommendations.

Mean intake of iron for these female athletes (11 mg) was below the RDA. Intakes of a large majority (88%) fell below the RDA; slightly more than one-third (36%) consumed less than two-thirds of the RDA. Twenty-two percent of the athletes consumed fewer than three meat exchanges (Table 2) and this may have influenced the iron levels in the diets of many athletes. Low iron intakes among athletes have been reported by a number of investigators (4,5,7,8). Manore et al. (5) reported a mean intake of 11.9 mg/day and found only two athletes who consistently consumed greater than two-thirds of the RDA over a three day period. Tilgner and Schiller (8) reported a mean intake of 13.2 mg/day and reported that many intakes were below 70% of the RDA. Hickson et al. (4) found a mean intake of 57% of the RDA for gymnasts and basketball players. Short and Short (7) reported low mean intakes for athletes on all women's teams.

It has been suggested that iron deficiency may impair athletic performance and that athletes may be at increased risk of deficiency due to high iron losses from red blood cell destruction, in sweat, and from gastrointestinal blood loss. Female athletes are also at increased risk due to iron losses during menstruation (17). Consuming the RDA for

iron requires special attention by female athletes to lower the risk of developing iron deficiency (17).

Mean intakes of calcium (872 mg) also were below the RDA for a large majority of these athletes (86%). The low mean number of milk exchanges consumed per day (1.2 exchanges) by athletes may have influenced this finding (Table 2). Twenty percent of the athletes consumed no milk exchanges at all in the three day period. The mean percentage of the RDA for calcium (73%) was similar to the 75% reported by Nowak et al. (6). Other researchers (4,7,8) have reported calcium intakes ranging from 88 to 102% of the RDA. Although amenorrhea among the female athletes in this study was not assessed, calcium intake should be of special concern to female athletes especially those who are amenorrheic. Amenorrhea has been found to result in an increase in bone loss, which may contribute to the development of osteoporosis (17).

Mean intakes of vitamin C greatly exceeded the RDA (205%). This is consistent with Hickson et al. (4), Manore et al. (5), and Short and Short (7) who reported intakes for athletes of 106%, 173%, and 263% of the RDA, respectively. Nowak et al. (6) reported a mean intake of only 92% of the RDA. Slightly more than one-fourth of these athletes in the present study consumed four or more fruit exchanges per day (Table 2).

The recommendation for dietary fiber that is used as the standard for comparison in the Nutritionist III nutrient

analysis computer program is 22 g. Only four athletes in this study met this goal with the majority (61%) consuming 10 g or less of dietary fiber. Nowak et al. (6) reported female college basketball players only consumed a mean of 2 g of dietary fiber per day. Nowak et al. attributed this to the limited consumption of whole grains, fruits, and vegetables by the athletes. The low mean number of vegetable exchanges consumed by athletes (0.5 exchanges/day) may also have influenced the findings from this study (Table 2). Approximately 80% of the athletes consumed less than one vegetable exchange per day.

Relationship to nutrition knowledge. Athletes were asked to respond to 28 knowledge items related to sports nutrition topics. Specific results from the knowledge test are reported elsewhere (10).

Pearson product-moment correlational analyses indicated there were positive correlations between knowledge score and fruit ($r=.36$, $p=.05$) and bread ($r=.24$, $p=.05$) exchanges consumed by athletes. This suggests that athletes who were more knowledgeable about nutrition consumed more fruit and bread. Similar results were found between knowledge scores and iron ($r=.33$, $p=.01$) and fiber ($r=.36$, $p=.01$) intakes of athletes, suggesting that the more knowledgeable athletes had more adequate intakes of these food components. Correlational analyses conducted separately for athletes participating in particular sports revealed positive correlations between knowledge scores and

intakes of iron (r=.68, p=.01), fiber (r=.61. p=.02) and bread (r=.68, p=.01) for track and field team members, between knowledge scores and intakes of vitamin C (r=.57, p=.03) and fruit (r=.63, p=.02) for softball players, and between knowledge scores and intakes of vegetables (r=.65, p=.05) for volleyball players.

Conclusions

The results of this study suggest that although the dietary intakes of many female college athletes appear favorable; many others have dietary practices that need improvement. Some athletes' diets seem to be low in calories and a variety of nutrients. The iron, calcium, and calorie levels of the diets of female college athletes appear to be areas that require special attention among nutrition educators. Many athletes consume less milk, fewer vegetables, and more fat than is generally recommended. More education materials are needed to address important topics that may affect athletic performance and the health status of athletes. Such topics should include making better food choices and the importance of consuming a balanced diet. This study suggests that athletes who are more knowledgeable about nutrition have more healthful diets than do those who are less knowledgeable. Nutrition education may help improve dietary practices of athletes.

The results of this study also suggest that there are few, if any, differences in dietary intakes of female

athletes participating in different sports. If this is the case, nutrition education programs may not need to be targeted to athletes in each individual sport. Additional research with a larger sample, however, is needed to confirm these results. Ongoing research is also needed to accurately assess the specific nutrient needs of athletes and to develop effective nutrition education programs for athletes.

Table 1. Intakes of energy, dietary fiber, and selected nutrients of female college athletes.

Nutrients	Range	Mean[1] Intake	Mean[1] % Recommended Level	Mean[1] % Calorie Distribution[2]
energy (kcal)[3]	969-4077	1893±597	72±23	----
protein (g)	17-162	67±28	148±62[4]	14±4
carbohydrate (g)	107-532	259±83	----	54±9
fat (g)	13-148	65±26	----	31±7
iron (mg)	4-29	11±4	71±28[4]	----
vitamin C (mg)	13-367	123±89	205±148[4]	----
calcium (mg)	238-2743	872±519	73±43[4]	----
dietary fiber (g)	0-33	11±6	49±27[5]	----

[1] Mean (± Standard Deviation)

[2] Percents do not equal 100% due to rounding

[3] Energy based on individual estimation with Harris-Benedict Equation

[4] Percent of Recommended Dietary Allowances

[5] Recommendation for fiber used in Nutritionist III was 22g

Table 2. Food group exchanges[1] consumed by female college athletes.

		% Distribution[2]				
		Number of Exchanges				
Food exchanges[1]	Mean±S.D.[3]	<1	1-3	3.1-5	5.1-7	>7
milk	1.2±1.5	48	43	4	3	1
vegetable	0.5±0.7	78	17	1	0	0
fruit	2.5±2.6	39	20	23	12	6
bread	9.2±3.5	0	0	6	20	74
meat	4.7±2.5	7	14	38	25	16
fat	10.4±4.5	0	1	6	16	77

[1] Exchange Lists for Meal Planning. Washington, D.C.: American Diabetes Association, and Chicago: American Dietetic Association, 1989.
1 milk exchange = 1 cup milk or yogurt
1 vegetable exchange = 1 cup raw, 1/2 C cooked
1 fruit exchange = 1/2 C fresh fruit or juice
1 bread exchange = 1 slice bread, 1/2-3/4 C starchy vegetable, 1/2 C rice or pasta
1 meat exchange = 1 oz meat, poultry, fish, or cheese
1 fat exchange = 1 tsp butter, margarine, or oil, 1 Tbsp salad dressing

[2] Percents do not always equal to 100% due to rounding.

[3] Mean ± Standard Deviation

REFERENCES

1. McArdle, WD, Katch, FI, Katch, VL. Exercise Physiology: Energy, Nutrition, and Human Performance. 3rd ed. Philadelphia: Lea & Febiger; 1991.
2. Werblow, JA, Fox, HM, Henneman,A. Nutritional knowledge, attitudes, and food patterns of women athletes. J Am Diet Assoc. 1978; 73:242-245.
3. Food and Nutrition Board: Recommended Dietary Allowances. 10th ed. Washington, DC: National Academy of Sciences; 1989.
4. Hickson, JF, Schrader, J, Trischler, LC. Dietary intakes of female basketball and gymnastics athletes. J Am Diet Assoc. 1986; 86:251-253.
5. Manore, MM, Besenfelder, PD, Wells, CL, Carroll, SS, Hooker, SP. Nutrient intakes and iron status in female long-distance runners during training. J Am Diet Assoc. 1989; 89:257-259.
6. Nowak, RK, Knudsen, KS, Schulz, LO. Body composition and nutrient intakes of college men and women basketball players. J Am Diet Assoc. 1988; 88:575-578.
7. Short, SH, Short, WR. Four-year study of university athletes' dietary intake. J Am Diet Assoc. 1983; 82:632-645.
8. Tilgner, SA, Schiller, MR. Dietary intakes of female college athletes: the need for nutrition education. J Am Diet Assoc. 1989; 89:967-969.

9. Carruth, BR, Mangel, M, Anderson, HL. Assessing change - proneness and nutrition-related behaviors. J Am Diet Assoc. 1977; 70:47.

10. Kruto, DB. Nutrition knowledge, interests, and dietary practices of female college athletes. Charleston, IL: Eastern Illinois University; 1993. Thesis.

11. Gronlund, NE. Measurement and Evaluation in Teaching. 3rd ed. New York: Macmillan Publishing; 1976.

12. Exchange Lists for Meal Planning. Washington, D.C.: American Diabetes Association, and Chicago: American Dietetic Association, 1989.

13. Zeman, FJ. Clinical Nutrition and Dietetics. 2nd ed. New York: Macmillan Publishing; 1991.

14. SAS Institute, Inc. SAS User's Guide: Statistics. Version 6.06. Cary, NC; 1989.

15. Welch, PK, Zager,KA, Endres, J, Poon, SW. Nutrition education, body composition, and dietary intake of female college athletes. Phys Sportmed. 1987; 15(1): 63-69,74.

16. Sorenson, SW, Calkins, BM, Connolly, MA, Diamond, E. Comparison of nutrient intake determined by four dietary intake instruments. J Nut Educ. 1985; 17(3): 92-99.

17. Nutrition for physical fitness and athletic performance for adults: technical support paper. J Am Diet Assoc. 1987; 87:934-938.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

This study examined the nutrition knowledge, interests, and dietary practices of 69 female college athletes. The data obtained from the athletes were analyzed to determine the current level of nutrition knowledge, to evaluate their dietary practices, to examine potential relationships between their nutrition knowledge and dietary practices, to explore their level of interest in nutrition education, to determine the nutrition topics and delivery methods of most interest to them, and to explore possible differences among those participating in different sports. Female college ahtletes were found to be generally knowledgeable about nutrition, however, some athletes still held common misconceptions concerning optimal nutrition for athletes. No differences were found between the knowledge levels of female college athletes of different sport teams.

After assessing the dietary intakes of the female college athletes, the analyses suggest that athletes consume fairly well-balanced diets. Although the overall intakes were favorable, there were still many dietary practices among these athletes that are in need of improvement. No significant differences were found between the dietary intakes of athletes participating on different sport teams. When comparing the nutrition knowledge to the dietary intakes of the female college athletes, few correlations were found, although all were positive. This

suggests that those athletes who were more knowledgeable had intakes that more closely reflected the Recommended Dietary Allowances for those nutrients.

The responses to the interest statements suggest that the female college athletes were quite interested in a variety of nutrition topics. Few significant differences in interest level were found between female athletes of different sports. With regard to the preferred delivery method, printed materials were the methods of choice for most of the athletes with no significant differences found between sport teams. The fact that printed materials were the most preferred delivery methods indicates that items such as pamphlets and newsletters may be most effective for presenting nutrition information to this population.

These results indicate that there are minimal differences between the nutrition knowledge, interests, and dietary intakes of female college athletes participating in different sports. The needs and interests of the athletes in this sample population were found to be essentially the same. This suggests that nutrition education does not need to focus on each sport team individually. Therefore, a successful nutrition education program for female college athletes may be targeted toward the population rather than each subgroup of the population. By enhancing the nutrition knowledge of female athletes, the athletes may be able and more willing to practice recommended behaviors in regard to nutrition for good health and optimal athletic performance.

Further research is needed to determine the relationship between nutrition knowledge and dietary behavior. Additional research is also needed to determine the most effective method of presenting nutrition information to athletes in order to develop effective nutrition education programs.

BIBLIOGRAPHY

Barr, S.I. (1987). Nutrition knowledge of female varsity athletes and university students. Journal of the American Dietetic Association, 87, 1660-1664.

Borgen, J.S. & Corbin, C.B. (1987). Eating disorders among female athletes. The Physician and Sportsmedicine, 15(2), 88-90+.

Carruth, B.R., Mangel, M., & Anderson, H.L. (1977). Assessing change - proneness and nutrition-related behaviors. Journal of the American Dietetic Association, 70, 47.

Exchange Lists for Meal Planning. (1989). Washington, DC: American Diabetes Association, and Chicago: American Dietetic Association.

Food and Nutrition Board. (1989). Recommended Dietary Allowances (10th ed.). Washington, DC: National Academy of Sciences.

Gronlund, N.E. (1976). Measurement and evaluation in teaching (3rd ed., pp. 111-113). New York: MacMillan Publishing.

Hickson, J.F., Johnson, C.W., Schrader, J.W., & Stockton, J.E. (1987). Promotion of athletes' nutrition intake by a university foodservice facility. Journal of the American Dietetic Association, 87, 926-927.

Hickson, J.F., Schrader, J.W., & Trischler, L.C. (1986). Dietary intakes of female basketball and gymnastics athletes. Journal of the American Dietetic Association, 86, 251-253.

Manore, M.M., Besenfelder, P.D., Wells, C.L., Carroll, S.S., & Hooker, S.P. (1989). Nutrient intakes and iron status in female long-distance runners during training. Journal of the American Dietetic Association, 89, 257-259.

McArdle, W.D., Katch, F.I., & Katch, V.L. (1991). Exercise physiology: Energy, nutrition, and human performance (3rd ed.). Philadelphia: Lea & Febiger.

Nowak, R.K., Knudsen, K.S., & Schulz, L.O. (1988). Body composition and nutrient intakes of college men and women basketball players. Journal of the American Dietetic Association, 88, 575-578.

Nutrition for physical fitness and athletic performance: Technical support paper. (1987). Journal of the American Dietetic Association, 87, 934-938.

Parr, R.B., Porter, M.A., & Hodgson, S.C. (1984). Nutrition knowledge and practices of coaches, trainers, and athletes. The Physician and Sportsmedicine, 12(3), 126-138.

Perron, M. & Endres, J. (1985). Knowledge, attitudes, and dietary practices of female athletes. Journal of the American Dietetic Association, 85, 573-576.

Potter, G.S. & Wood, O.B. (1991) Comparison of self- and group-instruction for teaching sports nutrition to college athletes. Journal of Nutrition Education, 23, 288-290.

Rosen, L.W. & Hough, D.O. (1988). Pathogenic weight-control behaviors of female college gymnasts. The Physician and Sportsmedicine, 16(9), 140-143+.

Statistical Analysis System. (1989). Cary, NC: SAS Institute, Inc.

Schoaf, L.R. McClellan, P.D., & Birskovich, K.A. (1986). Nutrition knowledge, interests, and information sources of male athletes. Journal of Nutrition Education, 18, 243-245.

Short, S.H. & Short, W.R. (1983). Four-year study of university athletes' dietary intake.Journal of the American Dietetic Association, 82, 632-645.

Sorenson, S.W., Calkina,B.M., Connolly, M.A., & Diamond, E. (1985). comparison of nutrient intake determined by four dietary intake instruments. Journal of Nutrition Education, 17, 92-99.

Tilgner, S.A. & Schiller, M.R. (1989). Dietary intakes of female college athletes: The need for nutrition education. Journal of the American Dietetic Association, 89, 967-969.

Updegrove, N.A. & Johnson, R.M. (1987). Using table tents to present sports nutrition facts to collegiate athletes. Journal of Nutrition Education, 19, 302D.

Welch, P.K., Zager, K.A., Endres, J., & Poon, S.W. (1987). Nutrition education, body composition, and dietary intake of female college athletes. The Physician and Sportsmedicine, 15(1), 63-69,74.

Werblow, J.A., Fox, H.M., Henneman, A. (1978). Nutritional knowledge, attitudes, and food patterns of women athletes. Journal of the American Dietetic Association, 73, 242-245.

Zeman, F.J. (1991). Clinical nutrition and dietetics (2nd ed.). New York: MacMillan Publishing.

APPENDICES

Appendix A

Eastern Illinois University
Female College Athletes
Questionnaire
Code Number _____

Record each of your answers to the statements below by filling in the corresponding circles on the answer sheet provided. Please use a pencil.

We would like to know what nutrition or diet related topics are of interest to female college athletes. Please indicate how interested you are in each topic listed using the scale:

a = not at all interested
b = somewhat interested
c = very interested

1. Nutrient supplements
2. Weight loss
3. Weight gain
4. General dietary recommendations for good health
5. Calorie content of foods
6. Carbohydrate content of foods
7. Fat content of foods
8. Fluid intake
9. Relationship of diet to performance

Any others? (please list and indicate how interested you are)

10. _____
11. _____
12. _____

We are also interested in knowing how to best provide nutrition information to female college athletes. Please indicate how interested you would be in each of the delivery methods listed using the scale:

a = not at all interested
b = somewhat interested
c = very interested

13. Printed materials (pamphlets, flyers)
14. Regular newsletters (once a week/month)
15. Seminars
16. Videotapes
17. Nutrition hotline
18. Calorie/nutrient content of foods served in food service
19. Table tents, posters in food service

Any others? (please list and indicate how interested you are)

20. _____
21. _____
22. _____

Some nutrition questions are given below. Please choose the best answer and fill in the corresponding circle on the answer sheet.

23. The protein needs of most athletes are _____ the needs of nonathletes.
    a. substantially lower than
    b. substantially higher than
    c. essentially the same as

24. How much carbohydrate is recommended in the training diets of most athletes?
    a. 40-50% of calories
    b. 50-60% of calories
    c. 60-70% of calories
    d. greater than 70% of calories

25. The pre-event meal should be consumed _____ hours before the event.
    a. 1-2
    b. 3-4
    c. 5-6
    d. no specific amount of time

26. Which of these foods is NOT an excellent source of complex carbohydrates?
    a. orange
    b. white bread
    c. pasta
    d. rice

27. The pre-event meal of an athlete should be _____.
    a. high in carbohydrate and high in protein
    b. high in carbohydrate and low in fat
    c. high in protein and low in fat
    d. high in carbohydrate and high in fat

28. Which of these foods in NOT high in carbohydrates?
    a. candy bar
    b. corn
    c. bagel
    d. lean steak

29. After the event, an athlete's meal should be high in _____.
    a. carbohydrate
    b. protein
    c. fat
    d. carbohydrate and protein

30. To replace the electrolytes lost through sweat (such as sodium and potassium), an athlete should consume _____.
    a. a balanced diet
    b. vitamin/mineral supplements
    c. sports drinks

31. During the event, it is recommended that an athlete should drink _____.
    a. enough fluid to quench thirst
    b. 4-6 oz every 15 minutes
    c. 8-12 oz every hour

32. The recommended amount of fluid an athlete should drink to replace the fluids lost during the event is _____.
    a. 1 cup of fluid per pound of body weight lost
    b. 2 cups of fluid per pound of body weight lost
    c. enough to quench thirst

33. For most athletes, the recommended fluid to drink to replace fluid losses due to sweating is _____.
    a. cool water
    b. fruit juices
    c. salt drinks
    d. sports drinks

34. An athlete's main source(s) of energy is (are) _____.
    a. carbohydrate only
    b. protein only
    c. fat only
    d. carbohydrate and protein
    e. carbohydrate and fat

35. The risk of stress fractures may be increased when an athlete's diet is low in _____.
    a. calcium
    b. iron
    c. protein
    d. vitamin A

36. Anemia in female endurance athletes is often associated with diets low in _____.
    a. calcium
    b. iron
    c. protein
    d. vitamin A

Please answer the following true/false statements and record your answer by using the scale: a = true b = false

37. Glycogen loading (above and beyond a high carbohydrate diet) is a technique that almost all athletes should follow.

38. The calories needed among athletes are different for each athlete.

39. Most of the carbohydrates an athlete eats should be complex carbohydrates.

40. Vitamin and mineral supplements are necessary for optimal performance of the athlete.

41. Recommendations about weight gain, weight loss, or weight maintenance can best be made based on how many pounds you weigh.

42. Weight loss is not necessary when extra weight is due to increased muscle tissue.

43. Athletes may weigh more than their nonathlete counterparts due to increased muscle tissue.

44. Athletes are less likely to develop eating disorders if they follow good eating habits.

45. Eating more protein than is recommended helps to increase muscle mass and strength.

46. Eating a candy bar immediately before an event will not significantly enhance performance.

47. Consuming caffeine before an event will significantly improve performance of most athletes.

48. Muscle cramps in athletes are almost always due to a deficiency in potassium and/or sodium.

49. Drinking a sports drink during an event will not improve performance of most athletes.

50. Drinking water during exercise generally causes an upset stomach and is found to slow athletes' speed.

We would like to know a little bit of information about you. Please answer the following questions about yourself:

51. What is your age?

a. 17	d. 20	g. 23	j. 26 or over
b. 18	e. 21	h. 24	
c. 19	f. 22	i. 25	

52. What is your year in school?

a. freshman	d. senior
b. sophomore	e. graduate
c. junior	

53. Which sport team are you on?

a. basketball	d. tennis
b. softball	e. track/cross country
c. swimming	f. volleyball

54. Where do you live at school?
   a. on campus in a residence hall
   b. on campus in married student housing
   c. on campus in University apartments
   d. in a sorority residence
   e. off campus by yourself or with roommates
   f. off campus with your parents
   g. off campus with spouse and/or children

55. Have you ever taken a college course <u>specifically</u> devoted to nutrition?
   a. YES b. NO

   If so, please specify course _____

Appendix B

You are being asked to record your food intake for YESTERDAY. The accompanying form has been provided for your convenience. Please be as specific and accurate as possible. Wait for instructions from the researcher before completing the form. Please listen to the instructions carefully to aid in the accuracy of the data.
If you have any questions, ask the researcher for assistance.
All data collected is confidential.

Thank you for your time and cooperation.

Diane Kruto
Graduate Student
Eastern Illinois University

Dr. Carol Ries
Associate Professor
Eastern Illinois University

Eastern Illinois University
Female College Athletes
24 Hour Recall
Day One

We would like to have an idea of what you eat in a typical day. Using YESTERDAY as an example, please fill out the following. Please by specific. It is important to indicate how the food was prepared, any condiments that were used, etc.

Age _____ Code Number _____
Height _____ Date _____
Weight_____

Time/Place Eaten	Food	Description	Amount

You are being asked to record your food intake for TWO days. Some helpful hints and forms to record your food intake have been provided for your convenience. Please be as accurate and specific as possible. Upon completion of your food records, return them to your coach. If possible, please have them completed within the next five days to allow the researcher to begin the analysis of the data. If you have any questions about your food records, contact Diane at 581-2129 or Dr. Carol Ries at 581-6353.

Thank you for your cooperation and for contributing to the success of the ongoing research on female college athletes.

Diane Kruto
Graduate Student
Eastern Illinois University

Dr. Carol Ries
Associate Professor
Eastern Illinois University

HELPFUL HINTS FOR RECORDING FOOD EATEN ON YOUR FOOD RECORD

We emphasize that you be as specific and as descriptive as you can. This will aid the researcher in her analysis of the data. Your accuracy for the two-day food intake will be reflected in the outcome of the study. Thank you again for your cooperation.

Record food amounts in the following manner:

meat -- ounces

fruits & vegetables -- cups or by piece

liquid -- cups or ounces

Stack of 52 playing cards = 3 ounces of meat.

1 slice of American cheese = 1 ounce

1 fluid cup = 8 fluid ounces

1 pat of butter = 1 teaspoon

3 teaspoons = 1 tablespoon

Estimate to the best of your abilities the correct amounts. Be specific.

- If you had a piece of chicken, was it a leg, breast, or wing?
- How was it prepared? Roasted, fried, or baked?
- Did you have white or wheat bread, skim or whole milk?
- If you had a piece of fruit, was it small, medium, or large?
- Did you put anything on your food such as ketchup, mustard, mayonnaise?

Check labels for serving sizes.
Remember to distinguish between cooked and raw food items.
Specify which fast food restaurant you ate at.
- What did you have on your hamburger?
- Was it a double?

Record all liquid: water, pop, milk, sport drinks, juices, etc. You may want to measure out the capacity of a glass you typically drink out of to keep track of your liquid intake.

Eastern Illinois University
Female College Athletes
Food Record
Day Two

Please record what you eat throughout the day. Please be specific. It is important to indicate how the food was prepared, any condiments that were used, etc.

Age _____ Code Number _____
Height _____ Date _____
Weight _____

Time/Place Eaten	Food	Description	Amount

Eastern Illinois University
Female College Athletes
Food Record
Day Three

Please record what you eat throughout the day. Please be specific. It is important to indicate how the food was prepared, any condiments that were used, etc.

Age _____ Code Number _____
Height _____ Date _____
Weight _____

Time/Place Eaten	Food	Description	Amount